From teacher training to classroom activities: the USR-EFT Piemonte experience on AI in 2020 - 2024

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Abstract

The rapid evolution of technology in education presents both opportunities and challenges, making continuous professional development essential for teachers. Staying up to date with new tools is difficult due to the fast pace of change, but crucial for integrating technology into teaching and enhancing digital competence, which is vital for citizenship rights. Artificial Intelligence (AI) literacy, although an emerging topic globally, is largely missing from teacher education. Many educators lack the technical knowledge to use AI tools effectively in classrooms, highlighting the growing need for improved digital skills and AI training.

In this contribution, we will begin with the international and national background and frameworks, and then focus on the developments in Piedmont with an overview of teacher training programs on AI in recent years. We will explore how these programs have adjusted to the rapidly changing technological environment by integrating new tools, methods, and approaches to prepare educators with the necessary knowledge and skills to incorporate AI into their teaching practices effectively. Furthermore, we will outline the class activities with students that have been implemented based on these training paths and how these activities have evolved over the years.

Keywords

Artificial Intelligence, Teacher training, Classroom activities

1. Introduction

The rapid emergence and evolution of new technologies present both opportunities and challenges, particularly in the field of education. It is crucial that any training or professional development related to these technologies remains up to date and adaptable, as what is cutting-edge today could quickly become obsolete. Implementing emerging technologies in educational settings presents its own challenges [1]. Educators may find it difficult to stay current with the latest tools and methodologies due to the rapid rate of technological change. This is why continuous and responsive professional development for teachers is essential [2]. Moreover, new technologies are essential for improving digital competence, which is increasingly important for exercising citizenship rights. Without regular training, educators may struggle to effectively integrate new technologies into their teaching practices. As a result, this could potentially hinder the school's efforts to support students in promoting their rights of citizenship. Teachers often feel a strong need to thoroughly understand and become proficient in using new technological tools before they can confidently incorporate them into their daily lessons. Therefore, ongoing professional development is not only about keeping pace with technological advancements but also about empowering teachers to feel confident and competent in using these tools to enhance their teaching and enrich their students' learning experiences.

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AI literacy is an emerging research topic in global education but is largely absent in the context of teacher education [3]. Many of these AI tools are new to teachers. They may not have rich technical knowledge to use AI educational applications to facilitate their teaching, and to develop students' AI digital capabilities. As such, there is a growing need for teachers to equip themselves with adequate digital competencies to use and teach AI in their teaching environments [4].

In this scenario in 2016 the Ministry of Education, University and Research launched the Italian National Plan for Digital Education (Piano Nazionale Scuola Digitale — PNSD) for setting up a comprehensive innovation strategy across Italy's school system and bringing it into the digital age. As a part of this plan in 2018 the Territorial Training Teams (Équipe Formative Territoriali - EFT) were constituted to encourage and support the exploration of new organizational models and innovative teaching methods. Each Italian region has an EFT, whose members work both at regional level by supporting schools and teachers, and at a national level by developing training projects. In 2022 the EFT became a part of the Italian National Recovery and Resilience Plan/Next Generation EU program (PNRR).

In Piedmont, the EFT has always operated under the umbrella of the Regional Education Office (USR), which supports organizational flexibility, teaching, educational research, and gathers local needs to create training opportunities. Additionally, the USR is responsible for organizing and disseminating courses and resources. Since its beginning the EFT of Piedmont has focused its efforts on developing projects related to digital education, digital citizenship, media education, and Artificial Intelligence (AI). The team also promotes, supports, and oversees the design and implementation of training courses for teachers during the transition into the digital age. In this contribution, we will present the evolution of teachers' training on Artificial Intelligence in recent years and the effect of the training in classroom activities. Over the past five years, we have collaborated with local educational institutions. We supported the testing of an educational app developed by the Polytechnic of Turin [5]. Additionally, we worked with the University of Turin on applying AI to Astronomy [6] and developing media literacy [7]. We also organized three editions of a team web-based competition on AI with the Liceo Pellico-Peano training hub [8]. These collaborations resulted in training facilities for teachers, which will be discussed along with other courses below.

2. Background and frameworks

The background and the frameworks of our project are outlined by the Ministry of Education (Piano Scuola 4.0 [9]). Here we focus on some aspects about Artificial Intelligence in Education from UNESCO [10] and the EU Digital Education Action Plan (DEAP) [11]. The actions that we promoted can be classified in three different categories [12].

- *Learning with AI* involves using Artificial Intelligence-based tools in teaching to provide personalized and adaptive learning experiences.
- *Learning about AI* includes acquiring knowledge and skills related to Artificial Intelligence techniques (e.g. Machine Learning, ML) and AI technologies (e.g. Natural Language Processing), as well as understanding statistics and coding.
- *Learning for AI* means ensuring that all citizens are ready for the possible impacts that Artificial Intelligence may have on their lives. This involves helping them understand and delve into ethics, potential data distortions, and the potential impact on jobs from a human-centric perspective.

We will not cover the use of AI for analyzing data to understand how students learn, their progress, effective learning paths, supporting admissions, planning learning programs, and educational data mining.

In September 2020, the Digital Education Action Plan was adopted and subsequently two actions about AI were implemented. Action 6 defined ethical guidelines on the use of AI and data in teaching and learning for educators [13]; action 8 updated the European Digital Competence Framework to include AI and data-related skills (DigComp 2.2 [14]). We used these documents as a reference when planning our courses. We began by sharing their knowledge at the start of our meetings, and

eventually we demonstrated how our practical suggestions aligned with the examples and guidelines outlined in these documents.

The InnovaMenti project [15] was launched in 2021 with the aim of training teachers in educational methodologies. The project was developed by members of the EFT from all regions and was structured into modules, each focusing on a different methodology: gamification, inquiry-based learning, storytelling, tinkering, and hackathon. Each module included an introduction, an overview of digital tools and resources for implementing classroom activities, and four easy-to-use kits designed for different educational levels, from kindergarten to secondary school. All the modules were designed in accordance with the areas and competency levels of DigCompEdu [16]. Initially, the introduction was delivered through webinars, but the project later transitioned into a MOOC. Participants were asked to experiment with the kits in their classrooms and share the outcomes of the experimentation, such as students' projects. In the following years, the same approach was used to design other training projects focused on new technologies, STEM, and other methodologies.

In early 2024, the "InnovaMenti_Intelligenza Artificiale" [17] project was launched. It introduces an innovative framework for education that supports AI Education. The project not only applies to the InnovaMenti approach to AI, but also presents AI in a way that strongly relates to our daily lives, and it offers a valuable opportunity for educators and learners to gain insights into the integration of AI in educational settings. The project aims to improve teachers' and students' understanding and practical skills by demonstrating how this technology can be used in various situations and for problem-solving. It is divided into four modules, each focusing on everyday activities that promote learning through hands-on engagement. These modules are communicating (analyzing and creating texts), seeing (classifying and generating images), feeling (interacting with the real and virtual environment), and acting (managing complexity with automation). Each module is based on examples of AI from DigComp 2.2.

3. Teacher training

The USR-EFT Piemonte training on AI began in 2020, with the first sessions taking place in February at the PSD final at Liceo Cavour in Vercelli [18] and in March during the Riconnessioni Project webinars [19]. However, the specific training on AI had to be paused due to the pandemic emergency. During this time, the focus was on supporting teachers using basic online tools to engage students while schools were closed. In this section, we will outline the courses we organized from 2021 to 2024. We will start by discussing the main topics and how they have evolved over the years. Then, we will highlight some common features. In Table 1, we provide a summary of the courses, including the main topics without translating the Italian titles.

All our courses have been designed for any teacher, with a special focus on those in the humanities disciplines. Artificial Intelligence is a complex and rapidly advancing technology that includes a wide range of concepts, methodologies, and applications; however, AI provides several opportunities for cross-disciplinary projects. With this in mind, we have thoughtfully selected activities from both the STEM and humanities sectors. During the first two years the training project focused on introducing AI with these main goals: presenting resources and techniques to explain AI in simple terms (*learning about AI*), introducing and discussing ethical aspects, and promoting awareness (*learning for AI*). In the last two years, we have been training on specific tools and topics, introducing teaching methodologies, and discussing the challenges and opportunities of AI in education (*learning with AI*).

In the first two years, the courses mainly focused on the first three areas of DigCompEdu. This included emphasis on digital continuous professional development, selection, creation, and modification of digital resources, planning and implementation of digital resources in the teaching process, as well as experimenting with and developing new formats and pedagogical methods for instruction. Recently, we have also extended other areas, specifically assessment strategies, differentiation and personalization, active engagement of learners, information and media literacy, responsible use, and digital problem-solving.

All the courses follow a similar structure, despite differences in the number of meetings and total duration. They begin with a brief introduction to the topics, followed by a demonstration of tools for implementing learning activities. Participants were then encouraged to use these tools under the guidance of the trainers. Activities provided for various levels of digital competence and different

school grades. Teachers were also offered kits in the InnovaMenti style, which were ready and easy to use in classrooms. If necessary, teachers could receive support from trainers during classroom activities (see next section). Upon completion of the course, teachers were required to briefly share their experiences with students by filling out reports, forms, or uploading images on an online board.

Table 1

List of all planned courses, including topics, number of sessions, competence level based on DigCompEdu reference, and years. Further details like the original title are available on the USR and EFT Piemonte websites. Trainers involved are listed in the footnotes; if no indication is written, the authors themselves provided the training.

Topics	Sessions	Level	Year
Data analysis and visualization; introduction to computational notebooks and Python programming	3	B1	2021, 2022, 2023
History of AI; basic principles; ethics; image recognition and classification; chatbots	4	B1	2021
Assessment; AI literacy	3	B1	2021
History of AI; basic principles; ethics and chatbots in humanities[1]	3	A2	2022, 2023
Basic principles; ethics; image recognition and classification, chatbots, and IoT applied to STEM[2]	4	B1	2022, 2023
Algorithms; Big Data; filter bubbles and echo chambers[3]	3	A2	2022, 2023
Gamification and AI applied to art and music[4]	2	A1	2022, 2023
Unplugged activities on games for kids[5]	1	A1	2023
Ethics and new technologies[6]	1	A1	2023
Models; basic principles; gaming and gamification; unplugged tools[7]	4	A1	2023
Natural language processing and prompt engineering[8]	2	A1	2024
Image generation and STEM for kids[9]	1	A1	2024
Storytelling and AI in teaching/learning languages[10]	4	B1	2024
AI and podcasts to promote reading[11]	2	A1	2024

Most of the courses were held online because they were offered to the entire region. We used the Google Meet remote conferencing platform, which was provided by USR. When the number of participants exceeded 100, and we needed less interaction with the participants as well as attendance tracking, we used Cisco WebEx, also provided by USR. In the most recent courses, we began using WebEx also with smaller groups of teachers because it allows for parallel sessions. While teachers were always comfortable with Google Meet, they encountered some issues with WebEx. The courses were offered in person only twice.

The courses were structured according to the six levels of digital competence development outlined in the DigCompEdu progression model. Initially, we focused on courses for intermediate level teachers (B1 Integrator). This level was chosen because the teachers already had some IT knowledge, making it easier for them to use tools such as Learning Management Systems and remote conference systems. Additionally, they were open to learning new ideas and tools and could implement them autonomously. However, they were new to AI and required support in this area as they were not proficient enough to learn about it on their own. Level B1 teachers have been shown to be a good group to use for testing new tools before introducing them to a wider group of teachers.

[1] Barbara Baldi, Luca Basteris, Emilia De Maria, Carlo Valentini
[2] AP, Luca Basteris, Andrea Goia, Carlo Valentini
[3] Luca Basteris, Carlo Valentini, Daria Romiti
[4] Barbara Baldi, Luca Basteris, Germano Zurlo
[5] AP, Maria Rosa Rechichi
[6] AM, AP, Vera Tripodi (Politecnico di Torino)
[7] AM, AP, Maria Rosa Rechichi, Carlo Valentini, Giulia Ballatore (Politecnico di Torino), Martina Vanelli (Politecnico di Torino)
[8] Simonetta Siega in collaboration with EFT Lazio, EFT Lombardia, and EFT Toscana
[9] Simonetta Siega in collaboration with EFT Lombardia, EFT Sicilia, EFT Umbria, and EFT Veneto
[10] Raffaella Castellina, Mara Rechichi in collaboration with EFT Lazio, EFT Puglia, EFT Sicilia, EFT Toscana, and EFT Veneto
[11] Maria Rosa Rechichi in collaboration with EFT Marche

Later, we began with initial level courses (A1 Newcomer and A2 Explorer) to engage a larger number of teachers. The activities offered for these lower levels were also unplugged to offer resources and techniques to explain AI in simple terms.

We initially began with teachers from secondary schools (grades 6+) because it was easier to address topics such as the principles of AI and ethics. Recently, we have also introduced activities for kindergarten teachers, focusing on how machines can perform tasks autonomously through hands-on unplugged activities, mainly based on educational games. Alternatively, we have encouraged the use of machines to bring children's drawings or stories to life. In these cases, the online tools need to be used by the teachers.

In all our courses, we emphasized the use of online platforms, comparing the various opportunities available online; whenever possible, we recommended open-source tools. For some more details on the tools and the platforms used, see the following references [20, 21].

Table 2
List of all classroom activities, including topics, school name, number of students and teachers involved, number of sessions, year, and school grade. Trainers involved are indicated in the footnotes, as well the number of classes, if it is larger than one. If no indication is written, the author AP provided the training.

Topics	School	Year	Stud.	Teach.	Sessions	Grade
Basic principles, data analysis, image recognition, ethics	LS Gobetti, Torino	2021	20	1	5	11
Basic principles, Natural Language Processing, chatbots, sentiment analysis	LS Gobetti, Torino	2022	25	3	4	11
Basic principles, image recognition, awareness[1]	LS Antonelli, Novara	2022	38	1	2	12
Basic principles, image recognition, awareness	IIS Curie, Collegno (TO)	2022	18	2	3	10
Image recognition and Astronomy	IIS Darwin, Rivoli (TO)	2023	16	1	1	12
Basic principles and storytelling[2]	IC Bellini, Novara	2023	15	3	1	2
Image recognition and generation in Art[3]	L Alberti, Novara	2023	36	7	1	10
Basics principles, Deep Fake, awareness[4]	L Pellico-Peano, Cuneo	2024	49	2	3	10
Generative AI and book trailer[5]	IC Tommaseo, Torino	2024	43	3	1	2-4
Text 2 Image[6]	IC S. Ignazio, Santhià (VC)	2024	34	5	1	6-7
Support to teaching mother tongue language[7]	DD2, Domodossola (VB)	2024	65	6	1	5

[1] AP and Carlo Valentini, 2 classes
[2] Maria Rosa Rechichi and Carlo Valentini
[3] AP, Luca Basteris and Germano Zurlo, 2 classes
[4] Luca Basteris, 2 classes
[5] Maria Rosa Rechichi, 2 classes
[6] Raffaella Castellina, 2 classes
[7] Simonetta Siega, 3 classes

4. Classroom activities

Classroom activities were planned with some participants of the training courses who were interested in experimenting with new ideas and tools in their classrooms but were not yet comfortable doing so on their own. To address this, the trainers collaborated with the teachers to plan the activities and co-taught the lessons. This allowed the trainers to handle any technical difficulties while the teachers could focus on the educational aspects. Additionally, in this way the suggested kits were not just theoretical tools but were implemented in the teachers' daily reality.

Details of all the activities are listed in Table 2. The initial projects were more structured than the later ones because they involved a lot of experimentation for both students and teachers. They consisted of numerous meetings where the focus was gradually moving from the fundamental principles of AI (*learning about AI*) to the implementation of machine learning in current problems (*learning for AI*). For example, this included analyzing chest x-rays for pneumonitis diagnosis and applying Natural Language Processing to sentiment analysis. Over time, teachers became more proficient and were able to conduct their own experimentations, so classroom activities became more specialized and focused on applications or issues, such as the study of language (*learning with AI*). In recent years, we also supported the use of kits from the national projects InnovaMenti, which were designed for specific lesson activities.

The classroom activities had been designed not just for IT experts, but for all kinds of students. They were suitable for both humanities and STEM courses. We began experimenting with dual training (learning and working, PCTO) with students of grade 11+. In the past two years, we have also started working with children in kindergarten.

The teaching methodologies we adopted varied depending on the context, students' age, and the frequency of meetings. Storytelling and gamification were the most used methods, especially with younger students. In our approach to storytelling, we focused on a technique that was employed in one of the training modules of the InnovaMenti project [22]. The activity involved writing the continuation or the end of a story based on the outcome of a machine learning classification. The goal was to emphasize certain aspects of machine learning, including the potential effects of improper training. This approach worked not only with children but also with older students. On the other hand, gamification was primarily used with younger students, not only because it engaged them effectively, but also because it served as a good starting point to explain in a simple way how a machine can perform tasks in an automated manner.

In our initial activities, we extensively utilized online platforms, primarily for tasks such as image classification and developing chatbots. As we progressed, we integrated offline tools into our approach, incorporating unplugged activities for children whenever feasible and utilizing offline programming tools for older students. At present, we mainly use online tools for specific lesson activities focused on image classification or generative AI.

5. Conclusions and perspectives

The teacher training and the classroom activities seemed to respond to the needs. At the end of every training course, participants filled out a feedback form. The format of these forms has changed over the years to gather more detailed feedback from teachers, provide structured information, and make it easier to compare activities across different regions. However, these changes have made it difficult to compare certain data. Overall, teachers were satisfied with the courses, especially regarding the topics covered and the clarity of the language used by the trainers. Many expressed interests in delving deeper and improving, with some of them attending multiple courses to advance from lower to higher levels of competence. Some teachers found certain topics too complex, but this was mostly due to an inaccurate self-assessment of their skill level. While there are free tools available to help teachers assess themselves [23], only a few of them use these resources. As a result, teachers at an A1 level attended courses designed for B1 level. During online sessions, there were difficulties in the practical part, where teachers were asked to both follow and complete exercises simultaneously.

The InnovaMenti_Intelligenza Artificiale project introduces a new framework. It offers resources and techniques to explain AI in simple terms, as well as AI literacy kits, educational games, and evaluation tools. The project emphasizes creating best practices, and it was initially tested in secondary schools but can now be expanded to include younger students. The modules are based on everyday activities such as communication, observation, perception, and action, and they are connected to examples from DigComp 2.2. This sets the foundation for interdisciplinary activities that are well-suited for kindergarten and primary school. Given our experience over the past few years, we are going to support teachers in their classroom activities and help spread these activities.

When introducing new innovations in schools, it is crucial to assess their impact [1]. It is not enough to simply start using new methods and technologies; they must be integrated coherently with the curriculum, students' knowledge, and teachers' skills. Teachers need support and tools to incorporate these new technologies and methodologies into their lessons, which is important for both the teaching and assessment aspects. The activities we proposed present challenges that require students to combine knowledge and skills from various subjects. Implementing these innovations is easier in primary schools than in secondary schools. However, there is currently no comprehensive framework that seamlessly aligns teaching practices with pedagogical insights and assessment strategies in nontraditional settings. Developing and implementing an effective evaluation model for future projects will be essential.

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